WATER RESOURCES DEVELOPMENT PROJECT

# CHARLES RIVER DAM

CHARLES RIVER BASIN, MASSACHUSETTS

# DESIGN MEMORANDUM NO. 3 CONCRETE MATERIALS



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

FEBRUARY 1971



#### DEPARTMENT OF THE ARMY

# NEW ENGLAND DIVISION, CORPS OF ENGINEERS 424 TRAPELO ROAD

WALTHAM, MASSACHUSETTS 02154

IN REPLY REFER TO:

NEDED-E

19 February 1971

SUBJECT: Charles River Dam, Charles River Basin, Massachusetts,

Design Memorandum No. 3, Concrete Materials

Chief of Engineers

ATTN: ENGCW-E

In accordance with ER 1110-2-1150, there is submitted for review and approval Design Memorandum No. 3, Concrete Materials, for the Charles River Dam Project.

FOR THE DIVISION ENGINEER:

Incl (10 cys)

JOHN Wm. LESLIE

Chief, Engineering Division



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## WATER RESOURCES DEVELOPMENT PROJECT

## CHARLES RIVER DAM CHARLES RIVER BASIN MASSACHUSETTS

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1	Hydrology and Tidal Hydraulics	Nov 1970		
2	General Design, Site Geology and Relocations	Dec 1970		
3	Concrete Materials	Feb 1971	19 Feb 1971	
4	Embankments and Foundations	Apr 1971		
5	Pumping Station	May 1971	:	
6	Vehicular Viaduct	May 1971		
7	Navigation Locks and Facilities	Jun 1971		

# CHARLES RIVER DAM

# BOSTON, MASSACHUSETTS

# DESIGN MEMORANDUM NO.3

# CONCRETE MATERIALS

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# CHARLES RIVER DAM BOSTON, MASSACHUSETTS DESIGN MEMORANDUM NO. 3

### CONCRETE MATERIALS

- chusetts, will require approximately 84,000 cubic yards of concrete for construction of a pumping station, locks and viaduct. The concrete will be subjected to severe climatic conditions with alternate cycles of freezing and thawing during the winter months; therefore, for durability, air-entrained concrete is considered mandatory. The pumping station and the locks above mean low water will require a superior quality concrete. The viaduct and the locks below mean low water will require a regular quality concrete. In view of the quantity of concrete involved and the location of the project, the specifications will provide for use of a semi-automatic concrete plant using stationary or truck mixers. Due to the high utilization of the land in the project area and the limited area available at the project site itself, an on-site plant is not considered feasible; therefore, an off-site plant will be specified.
- 2. <u>CEMENTING MATERIALS</u>. The size of the monoliths will not result in excessive thermal stresses but the location of the structure involves sea water sulfate exposure; therefore, Type II portland cement will be required for the project. No special investigation of portland cement was conducted as cement in this area is usually

supplied by one of six mills located in the New York Hudson River Valley or from one of the eight mills located in the Pennsylvania Lehigh Valley. All fourteen mills manufacture Type II portland cement. There are no economically available sources of natural, slag, or portland blast — furnace slag cements available in this area; therefore, these types of cement will not be specified. Investigation of commercial sources of pozzolans (fly ash) indicates no economically available sources. Costs of handling and shipping of pozzolans more than offset savings gained by its substitution for portland cement; therefore, pozzolans will not be specified.

## 3. AGGREGATE.

a. <u>Field Investigation</u>. A field reconnaissance was performed in June and November of 1970 by an engineer geologist team to determine the available sources of concrete aggregates. Due to the size and location of the project site, there is a high probability that concrete will be obtained through a ready-mix concrete supplier; therefore, the available source investigation includes not only the potential aggregate sources in the project area but also those sources which normally supply the ready mix companies located in the project area. There are six potential sources of processed sand and gravel and three potential sources of processed crushed stone. Table II lists the sources and locations, plant capacity, and haul distance to the project site of each source of aggregate checked during the field reconnaissance.

### TABLE II

	Plant Capac (tons per h	Haul Distance (Miles)
Rowe Contracting Co., (1) Malden, Mass.	300	6
Old Colony Crushed Stone Co.(Quincy, Mass.	1) 400	ü
Lynn Sand & Stone Co., (1) Swampscott, Mass.	450	13
Burlington Sand & Stone Co. Burlington, Mass.	200	15
A. A. Will Sand & Gravel Corp Canton, Mass.	• 1100	17
M. Benevento Sand & Gravel Co Wilmington, Mass.	. 450	17
Glenview Sand & Gravel Co. Chelmsford, Mass.	300	26 (2)
Plainville Sand & Stone, Inc. Plainville, Mass.	500	30
Ossipee Aggregate Corp. Ossipee, N. H.	7100	100 (2)

- (1) Produce only crushed stone
- (2) Rail haul

The locations of the project site and the commercial sources of aggregate are shown on Plate 3-1. M. Benevento Sand and Gravel Company produces fine and coarse aggregate used in portland cement and bituminous concrete. Burlington Sand and Stone Company regularly use their fine and coarse aggregate in portland cement concrete. A. A. Will Sand and Gravel Company do not regularly use their coarse and fine aggregate in the production of portland cement concrete.

The aggregates produced by the plants of Lynn Sand and Stone Company (Coarse Aggregate), Plainville Sand and Stone Incorporated, (Coarse and Fine Aggregate), Ossipee Aggregate Corporation (Coarse and Fine Aggregate), and Glenview Sand and Gravel Corporation (Fine Aggregate) were selected for evaluation testing. These sources regularly supply the ready mix suppliers in the project area and are considered as having the best potential for supplying concrete aggregate for the project. Rowe Contracting Company and Old Colony Crushed Stone Company have been tested previously and current samples indicate that the materials are now identical to those previously tested. Photographs of working faces of Rowe Contracting Company. Old Colony Crushed Stone Company and Lynn Sand and Stone Company are shown on Plates 3-2 thru 3-4 respectively. The maximum size aggregates readily commercially available in this area are 1-1/2 inches. and based on increased costs of production for larger sizes and elimination of some aggregate sources, it is concluded that no economical advantage would be obtained by requiring a larger maximum size aggregate.

b. <u>Tested Sources and Estimated Prices</u>. The sources of aggregate tested and the estimated delivered prices to the project site of these aggregates, based on the quoted plant prices and Massachusetts Department of Public Utilities minimum trucking rates, which are currently twenty-five cents per ton for the first mile and five cents per ton for each additional mile are as follows:

- (1) Rowe Contracting Company. Quoted plant prices are \$2.00 to \$3.50 per ton for crushed stone depending on the size group. The delivered price to the site will average \$2.60 per ton for crushed stone.
- (2) Old Colony Crushed Stone Company. Quoted plant prices are \$2.40 to \$3.75 per ton for crushed stone, depending on the size group. The delivered price to the site will average \$3.21 per ton for crushed stone.
- (3) Lynn Sand and Stone Company. Quoted plant prices are \$1.90 to \$3.35 per ton for crushed stone, depending on the size group. The delivered price to the site will average \$2.89 per ton for crushed stone.
- (4) Glenview Sand and Gravel Company. Quoted plant prices are \$2.50 to \$3.75 per ton for gravel, depending on the size group and \$1.65 per ton for concrete sand. The delivered prices, by rail, will average \$4.25 per ton for gravel and \$2.90 per ton for concrete sand. Only the fine aggregate from this source has been evaluated by testing.
- plant prices are \$2.00 to \$2.30 per ton for gravel, depending on the size group and \$1.60 per ton for concrete sand. The delivered prices to the site will average \$3.76 per ton for gravel and \$3.30 per ton for concrete sand.

c. Aggregate Tests. Results of aggregate tests performed on materials from the four sources which have undergone evaluation testing for this project are summarized on Plate Numbers 3-5 through 3-8.

A petrographic examination of coarse aggregates from Rowe Contracting Company and Old Colony Crushed Stone Company indicated that the materials are now identical to those previously tested. Results of aggregate tests for these two previously tested sources are summarized respectively on Plate Numbers 3-9 and 3-10.

Results of the weathering tests show that the DFE (durability factor) of the tested sources range from a high of 87 to a low of 57. The DFE value of 57 represents a quality rating of good, but due to its relatively poor rating in comparison to the other sources tested, a DFE of 57 will be set as the lowest limit acceptable for aggregate to be used on this project.

- d. Concrete Making Properties of Aggregates. The water cement ratio and cement factor versus compressive strength curves developed by utilizing concrete aggregates for the sources tested are shown on Plate Numbers 3-11 through 3-14 for all sources except Old Colony Crushed Stone Company and Glenview Sand and Gravel Company for which test data are not available.
- e. Service Records. The aggregates from the tested sources have been used in concrete for a number of federal, state

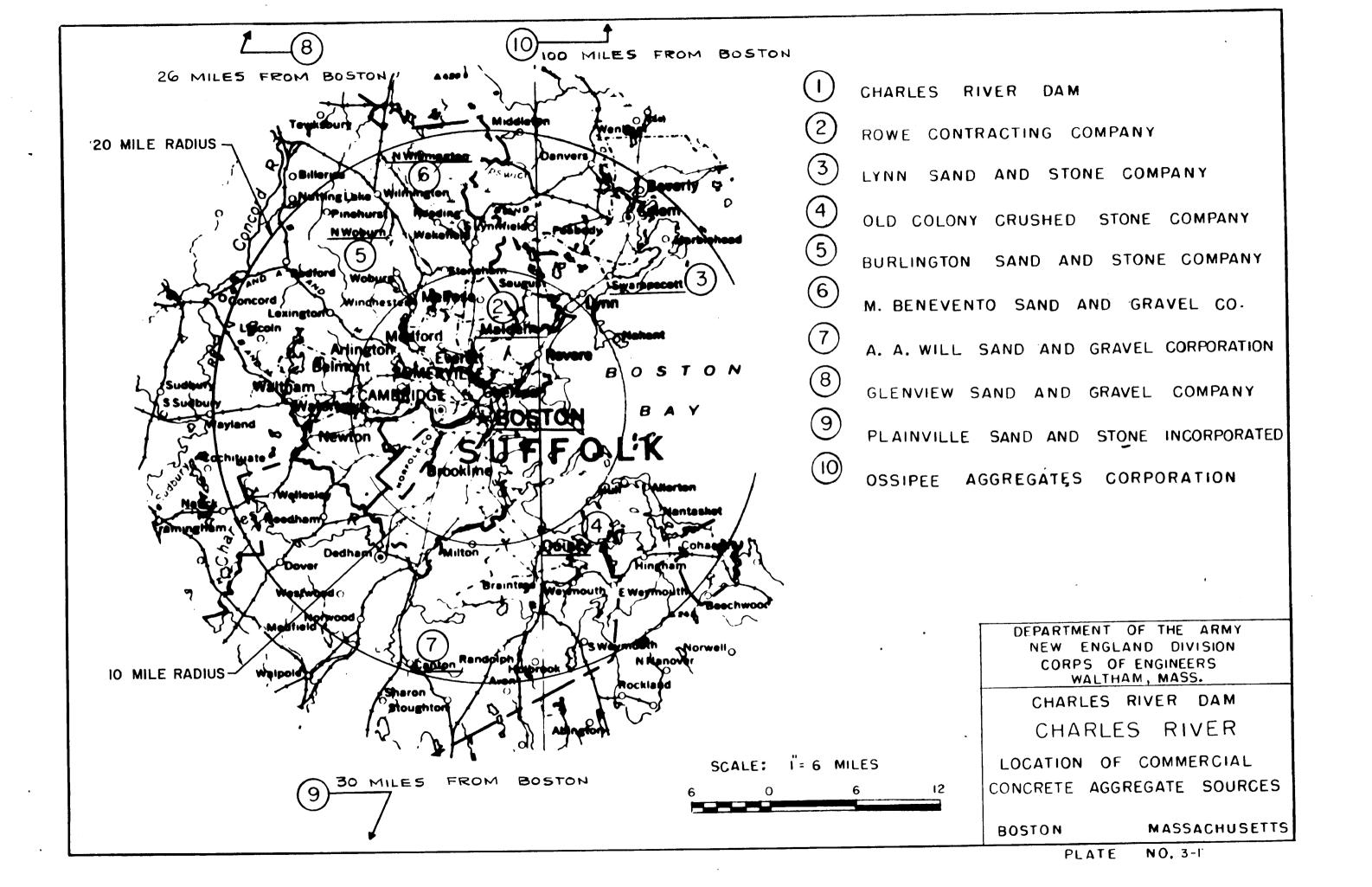
and local projects. Rowe Contracting Company has regularly supplied coarse aggregates for construction of state and private buildings in the Boston Area. Old Colony Crushed Stone Company regularly supplies coarse aggregate to Grazziano Transit-Mixed Company in Braintree, Massachusetts for local building construction. Lynn Sand and Stone Company supplies coerse aggregate used in state and private buildings, state highway bridges and military construction. Glenview Sand and Gravel Company supplies fine aggregate to Allied Concrete Company in Everett, Massachusetts and fine and coarse aggregate to E. A. Wilson Concrete Company, Andover, Massachusetts. Glenview Company aggregate has been used in many state buildings and on state highways. Plainville Sand and Stone. Incorporated fine and coarse aggregates have been used in state and federal structures. Ossipee Aggregate Corporation fine and coarse aggregates have been used in state and local structures. The performance of aggregates from all of the sources is considered satisfactory, although it must be noted the period of record is less than fifteen years.

adjacent to sea water. The use of sea water will not be considered for mixing or curing concrete. It is assumed that water for both mixing and curing will be obtained from a city water supply and since the exact sources could not be predetermined, tests were not performed. Sources of water proposed by the contractor for mixing and curing concrete will be tested prior to use. The water which will be impounded by the concrete structure has been tested to determine

whether it contains any concentration of deleterious chemicals which might affect the proportioning of concrete or the selection of cement type. The results of laboratory tests performed on the water sample indicate the water is essentially diluted sea water.

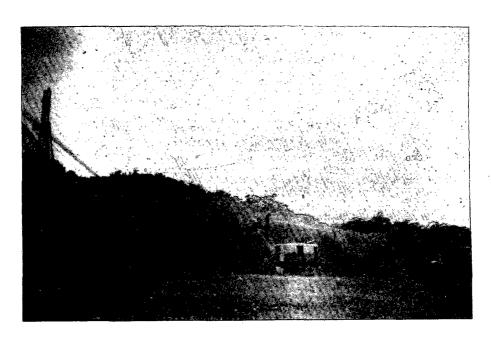
- 5. SOURCES OF CONCRETE. There are three sources of ready-mixed concrete within a six mile haul distance of the project site. Boston Sand and Gravel Company operates an automatic central-mix type concrete plant in Charlestown, Massachusetts approximately a one mile haul distance to the site. This plant is supplied with fine and coarse aggregates which are shipped, by rail, from Ossipee Aggregate Corporation, Ossipee, New Hampshire. Allied Concrete Corporation operates a semi-automatic central-mix type concrete plant in Everett, Massachusetts, approximately a three mile haul distance to the site. This plant is supplied, by rail, with fine aggregate from Glenview Sand and Gravel Company, Chelmsford, Massachusetts and coarse aggregate. by truck. from Lynn Sand and Stone Company, Swampscott, Massachusetts. J. H. McNamara, Incorporated, operates an automatic transit-mix type concrete plant in Allston, Massachusetts, approximately a five mile haul distance to the site. This plant is supplied, by truck, with fine and coarse aggregates from Plainville Sand and Stone, Incorporated, Plainville, Massachusetts.
- 6. RECOMMENDATIONS AND CONCLUSIONS. Based on data presented herein, it is considered that aggregate from any of the six sources tested is acceptable and it is recommended that fine aggregate from

the three tested sources and coarse aggregate from the five tested sources, as listed, be approved.





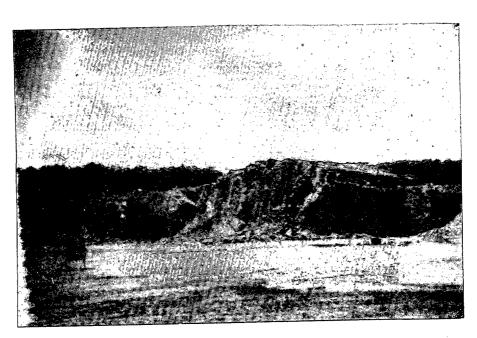
Rowe Contracting Company Malden, Massachusetts Quarry Face 2000 feet long



Rowe Contracting Company Malden, Massachusetts Quarry Face 100 feet high



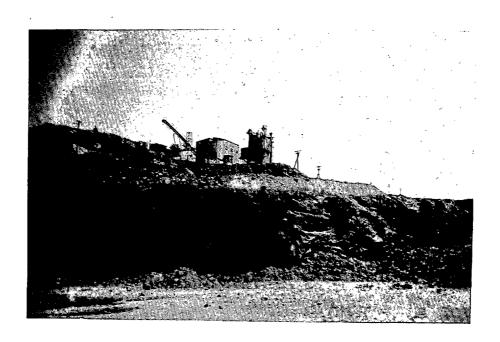
Old Colony Crushed Stone Company Quincy, Massachusetts Quarry Face 2000 feet long



Old Colony Crushed Stone Company Quincy, Massachusetts Quarry Face 150 feet high



Lynn Sand and Stone Company Swampscott, Massachusetts Quarry Face 2000 feet long



Lynn Sand and Stone Company Swampscott, Massachusetts Quarry Face 120 feet high

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F.M.(b)  HORTAR- LOW-A  HIGH- SOUNDNE  FINE  FINE  PETROGRA  Aphani  Physic  Ured  rock p	BAR EX LH. CEN N.H. CEN N.GG. G NGG. G APHIC itic cally with parti	PANSION PANSIO	N AT 10  ETE (CR  iew S  1 Co.  cre-c  ediur  ther:  are	6,35 or, % or, % or, % No. No. 10 or or o	(CAD- COUNTY EQUITY  O, 114  & Olympian  SUMM  ainecal is  orimanari	VALENT: VALENT: VALENT: COMMSE A FORME, A ARY: d igne s of a arily ly har	3 MO.  RES.  The c: lous rengula: confined, der	Lynn Srushed ocks rapart:	Sand & quarranging icle & the g	Stone ry stone g from shape, granit:	OFE DOO OFE DOO	57 comprese to	ised grarougieti	of nite	HD-CW
F.M.(b)  LOW-A  HIGH-  SOUNDNE  FINE  Appliant  Physic  cured  rock particles  started  started  started  cock particles  started	BAR EX LK CEN LK CEN SS IN G AGG. G APHIC Ltic Cally with parti	ENT: CONCRETE Lenv rave para ( to m , th wea cles egre	6.88 NAT 10 ETE (CRE-C iew S 1 Co. cre-c edium e mat ther: are e of	6,35 of, %o %o No. %o %o No. %o co No. %	(CRD- CEQUIDO, 114 & COMM SUMM SINGE CACHE CACHE	VALENT: VALENT: VALENT: VALENT: DECORASE A FORME, A ARY: d igne s of a arily ly har weath	3 MO.  Ress. The crous rengular confined, den	Lynn Srushed ocks reparts ned to use and	Sand & quarranging icle : the gd unwert	stone ry stone g from shape, granit:	OFFE DOO OFFE DOO DOOF E DOO DOO IS O CONTROL SMOOTH SMO	57 comprise to	ised gra rougietiy 3% ba	of nite	HD-CW HD-CW The owing
FINE A  PETROGRA  Physic  Cock I  Ra Slig  Che th	C 105  BAR EX  LK CEN  LK CEN	PANSION TENT: CONCRETE LENV TAVE PATA ( to m , th , wea cles egre tica	S.88 N AT 10 LITE (CR LEW S L Co. CRO-C Ledium e mat ther: are e of L max	6,35 of, %o %o No.26 %o	(CRD- CEQUITO, 114 & SUMM ained al is orimated ace 1 dep	VALENT: VALENT: VALENT: ): COARSE A FORMAL ARY: d igne s of a arily ly har weath nsity	3 MO.  RESS. The cangular confined, dening blend	Lymn S rushed ocks r r part ned to nse and The	Sand & quarranging icle : the ; d unwe partioximat	Stone ry stone g from shape, granit: eathere cle ce tes the	OFE Suce DEFE TOO  ne is conditionately ic rocked with	57 comprese to	ised grarougietiy 3%, ba	of nite es. she sed cent	HD-CW HD-CW The owing on sages:
MONTAR- LOW-A HIGH-A SOUNDNE FINE PETROGRA Aphant Physic tured rock particles the the	BAR EX LK. CEN NLK CEN SS IN C AGG. G APHIC itic cally with partic tht d leore orit	CONCRETE CONCRETE Lenv rave para ( to m r, th wea cles egre tica e, 1	N AT 10  ITE (CA  IEW S  CAB-C  edium  e man  ther: are  e of  1 max  3% Gn	6,35 of, % of,	(CRD-	VALENT: VALENT	3 MO.  RES. The crous reangular confinering blend, 5% Dar	Lynn S rushed ocks r r part: ned to nse and The appr rk Aph	Sand & quarranging icle : the : d unwe partioximatenitic	Stone ry stone g from shape, granit: cathere cle co	OFFE DOO OFFE DOO DOOF E DOO DOO IS O CONTROL SMOOTH SMO	57 compres to to var onlients wing	ised grarougietiy 3%, ba	of nite es. she sed cent	HD-CW  HD-CW  The owing on cages:

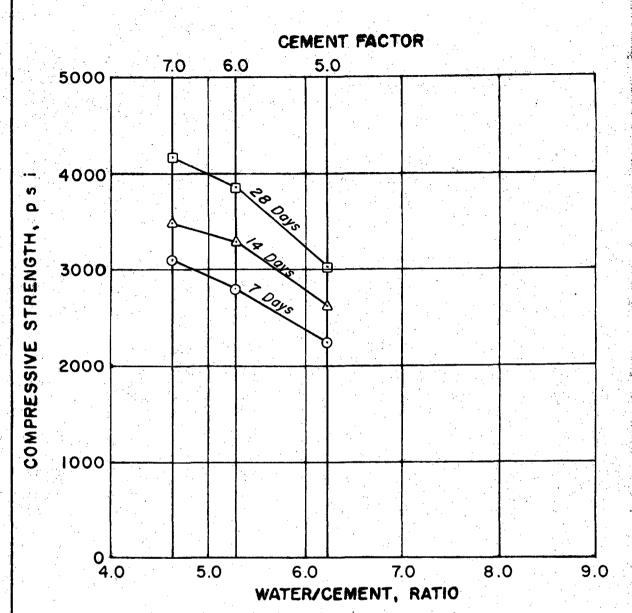
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	Mas:	5.	<del></del>	1G.:		Or v			T	TF: Co-	NED L	aborat	ory	
LAB. SYN	-	. 90			71	W	T PULL	JILE	TYPE O	Ser	tember	197U	l & Gra	
		dia on	<u>-/-</u>	l th	ב ומ	ni nwi 7	le. Ma				Proc	Sand	_K_Gra	AOT-
	1.101	OTP ON	50.	1000	<u> </u>	ariiA TT	LLO Má	155.					· · · · · · · · · · · · · · · · · · ·	
PRODUCE	<b>9</b> : 177 :		77.	<u> </u>	<u> </u>	1 01		<del></del>				·		
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BAMPLED	RY:	MET	Λ.	0	osel	1	<del></del>	<del></del> .	<del></del>					
TESTED					er Da		<del></del>						<del></del>	
USED AT	<del></del>	CHAL	THS.	יאירט	er D	311	***********					<del></del>		· · · · · · · · · · · · · · · · · · ·
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PROCES	SING .	EFORE	TEST	ING	Cras	shing.	Sizir	ng and	Magh	ing ha	Produ	207		
EOLOGIC	CAL FOR	MOITHER	ANO	AGE:			ent Ter							•
				4. 1			****			ı		1		
GRADING	(CAD-	C 103)(	CUM.	To PAS	SING):		ΤE	ST RE	SULT:	5				FINE
IZE/					FINE					·	그를	4	3/44	AGG
SIEVE	그릇미		3//٢		AGG.	BULK SP	. GR , SAT	SURF DRY	(CRD-	107,108)	2.6	7 2	66	2.6
6 IN.	_	·					TION, PER C				0.9		.23	1.3
5 IN.					·	<del></del>	IMPURITI			·				_
41N.						<del></del>	ARTICLES,					1. 1		
3IN.			·							(CRD-C				
2 j IN.				<u> </u>			<del></del>				2.0			
2 IN -	100					<del></del>				(CRD-CI	(5)		7.2	2.5
1 1 IN.	99					•	N LOSS (I						7.4	
I IN.	55		100				r., LB/CU				100	4 1	102.2	_בנו
ŽIN.	10		99	ļ	<b></b>	CLAY L	JMP5, %	(CRD-C I	(8)			+		
§ IN.	2		_47		<b></b> -				- (			++		<del></del>
\$1N. NO.4	1		23	<del> </del>	-					D-C (24): 126): \$c,n		+		
NO. 8	-1		8			MEACTIV	nit wiln	NOUT (	JHD-C			++		-+
NO.16	-	<del>-                                    </del>	<u>lı</u>		87	MORTAG	- MAKING	PPOPERTU	* (CD)		MA/L¢			
NO. 30	-		ځ		1 67	TYPE	TT CEM	EMT. DATI	· 7	DAVS 1	וזל ת	28	DAYS,	112 4
NO 50	<del> </del> _	<del>-  </del>	2		<del>4</del>						(CRD-C		<u></u>	Lile -
NO. 100	0 2		1.2		24		ROCK			ARALLEL		<del></del>	AVE	RAGE
NO.200			0.8		7.7	<b> </b>						+		
- 500 <sub>(a)</sub>			0.8	<b>-</b>	7.8	1						1		
	200		7 2		2 7	1		··				<del>                                     </del>		
e) CRD-		(b) CR	<u>رحمΩ</u> ۱۱ C ا	04	LCA!	MORTA	LR:							
								FINE AG	GREGAT	E	T	COARSE	AGGREGATE	
- PATRON	BAH EX	PAN3 ION	AT IC	)OF, 46	• (CMD-	-C (23):	3 MO.	6 MQ.	9 MC	. 12 MC	. 3 MO.	6 MO.	9 MO.	12 MO
LOW-	ALH, CEM	ENT:		70 No.	O EOU	VALENT:		,					:	
HIGH -	ALH.ÇEM	ENT:	-	% Na;	O EQUI	VALENT:				•				
SOUNDNE	35 IN C	CONCRE	TE (CF	10-C	40, 114	):						FAT	HW-CD	HD-CV
FINE	AGG. P	lainv	ille	∍ Saı	nd &	COARSE A	·cc·Plai	invill	3 Sar	id & St	O26 200	83		
	AGG. S						GG: Inc.				OF E 300		<u> </u>	
													ents o	
													proxim	
the f	collo	wing	per	ent	ages	: 51%	G <b>r</b> ani	ite, 2	5% Qu	ıartzit	е, 14%	Dark	Basic 1	Rock
											rate,			فديد ليو
Angul	Lar t	o sub	rou	nded	, pii	nk to	dark g	gray,	sound	aggre	gates	compri	sed of	53%
													The sl	
													a sound	
hard													l. Wea	
													ate fr	
_										_			ly rem	
uy wa ∴±	isning ided i	g, cn	T2 I	uat e	rıal	1s co	msider	red to	be o	of sati	sfacto:	ry qua	lity f	or th
I DT OY	inen 1	nse.												

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STATE:				EX NO.								NED La	borat	ory	-3
LAT.	420	N	LO	<b>V</b> G.: '	71°W		DATA	SHEE	T	DATE:	Se	eptembe	r 197	0	· į
LAB. SYM	BOL NO	).: <u>8</u>	2-2-	1				1	YPE	OF N	MIRSTAN	Proc.	Natu	ral Sa	and d
LOCATION	St									<del></del>					
		lmsf			<del></del>							· · · · · · · · · · · · · · · · · · ·			
PRODUCER							Compa			···		<del></del>			
		HIIAT	HW. D.	aut.		MAVEL	COMO	шу					<del></del>		
SAMPLED	ev:	MED		Co		1 0		<del> </del>						<del></del>	<del></del>
TESTED								<del></del>							
USED AT		Ollar.	192	TAA	r Dai	<u> </u>		<del></del>		<del></del>	<del></del>		<u> </u>		·
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PROCES		***	720	PINO			a Sie	ina a	7 To 2	Jo ch	ing }	T Drock	22002		
<del></del>											<del>,</del>	y Prod	IUCOT.	<del></del>	·
GEOLOGIC	AL POP	NO THEM	AND	AGE	GLa	cial (	ntwasi	ı-Plei	<u>sto</u>	cen	₽	· · · · · · · · · · · · · · · · · · ·	····	<del></del>	
	4000		<u> </u>			<del></del>						····	т т	<del></del>	12:::2
GRADING	(CRD-	(C 103)	(CUM.	76 PAS	SING)	ļ	TE	ST RE	SUL	TS					FINE
#ZE/					FINE	<b></b>									AGG.
SIEVE				ļ	<b>AGG.</b>			SURF DRY					ļ		2.61
61N.								ENT (CRD							1.77
SIN.				<u> </u>	<u> </u>			S, FIG. NO							_1_
4 IN.						<del></del>		PER CENT						· .	
31N.						<b></b>		R THAN S							
2 1N.						PER CEN	T FLAT A	ND ELONG	TED	(CRD-	C 119,12	0):			
2111						WEIGHTE	D AV. % LI	038, 5 CYC	Mg5	Ca (C	RD-C 11	5)			9.5
(∳IN.						ABRASIO	4 LOSS (L	۰. ۸.), ‰,	(CRD	-C 111	7):	7.1			
EIN,						UNIT WI	., LB/CU	FT (CRD-	C 100	8);					1071
∄ IN				,		CLAY LL	JMPS, %	(CRD-C 11	8)		-				
j IN.									-						
BIN.						SPECIFIC	HEAT, ST	U/LB/DEG.	F. (	CRD-C	124):				
NO.4					100			NaOH (				4/1.			
NO.8					89	4					Rc, m	<del></del>			
NO.16					73		MAKING	PROPERTIE	3 (C	RD - C	: 116)	<del></del>	<del></del>		
NO. 30					47	• -	CEMI	ENT, RATH	<b>7</b>	D	AYS. 77	53_	28	MYS ]]	6
NO 50					27							(CRD-C 12			
NO 100			· · · · · · ·	<del> </del>	문		ROCK					ACROSS		T AN	/ERAGE
NO.200				<del> </del>	1.7	<b> </b>					-	7.0	<del>                                     </del>		
- 500 <sub>[e]</sub>				<del> </del>		l		· · · · · · · · · · · · · · · · · · ·	-		<del></del>		<del> </del>		
F.M(b)					2.6	<b>┟├</b> ──	<del></del>					<del></del>			
(e) CRD-(	104	(+) 65	D-C I	04	2.00	MORTA			1				<u> </u>	!	
(a) CHU-	. 105	CENTRA	D-C 1	-		MORTA	r:	FINE AC				· ·			
- RATROM	BAR EX	PANSIO	N AT I	00F, %	(CRD-	C (23):		FINE AG				<del> </del>		AGGREGAT	<del> </del>
							3 MO.	6 MO.	9	MO.	12 MO.	3 MO.	6 MO.	9 MO.	12. MO,
LOW-A						VALENT:	<b>-</b>					ļ		<del> </del>	<del>                                     </del>
HIGH -A				· · · · · · · · · · · · · · · · · · ·		VALENT:	L					<u> </u>		<del> </del>	<del></del>
SOUNDNE										· ·			FAT	HW-CO	HD-CW
		envi						Sand					57	<u> </u>	
FINE A		Grav						mpsco				OF E 300		<u> 1</u>	<u> </u>
PET ROGRA	NPHIC I	BATA (	C#8-C	127):	SUM	MARY.	The r	atural	Ls	and	is co	mprise	ed of	smootl	ı sur-
												ayish g			
												on th			
tion o	f th	e pr	oces	sed :	natei	rial:	59% Qu	iartz 8	e Qi	uart	zite.	, 11% S	iltst	one.	L0%
Schist	. 8%	Gra	nite	. 6%	Felo	dspar.	5% Mi	ca. 19	g M	isce	llane	ous.	Pale	vello	, to
white.	den	se. Ì	nard	qu	artz	and o	uartzi	te par	tic	cles	com	rise 5	9% of	the	and.
3ligh <b>ť</b>	ly w	eath	ered	to	veath	ered	siltst	one ar	nd s	schi	st pa	rticle	s com	prise	21%
of the	siam	o <b>l</b> e m	with	appr	roxin	natelv	20% t	eing d	of i	fria	ble	tructu	re.	The so	hist
ortio	n co	nori	ses :	of 39	g phy	711it.i	c part	icles	ຕດາ	nsti	tutes	the w	eakes	t frac	eti m
	and	1s	Larg	elv /	conti	ned +	o the	+NO. 5	<del>n</del> e	יים רב	6 61	. AS		2 11 80	
RLMARKS:	~444		-or 8,	-J	- C11 T T	.1100 U	O OHG	1100	,	) T & A	à OTA	1 G 9 •			

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	N.H.			EX NO:	·			REGAT								У		
	MoET			16.: 7			DATA	SHEE				_		er 19				
LAB. SYM	BOL N	o.: 82	2-3-1	. thr	u 4			1	TYPE	OF I	MATERIA	M_:	Proc	. San	d &	Gra	vel	
LOCATION	Bou	te 10	5								**	-						
	088	ipee.	, Nev	7 Ham	pshi	re		٠.					,					
PRODUCE	088	sipe	Age	rega	te C	orpor	ation	<del></del>										
	· · · · · · · · · · · · · · · · · · ·																	
SAMPLED	BY:	NED	. A.	Car	osel	la												
TESTED	FOR:			Rive														
USED AT								······										
<del></del>		<del></del>			<del>,</del>				····		<del></del>							
PROCES	SING E	EFOR	E TEST	TING (	Crus	hing.	Sizin	g and	Was	hin	g by	Pr	oduc	er				
GEOLOGIC							Pleis				<u> </u>							
					DORO	<u></u>	1 7070	0000116		<u></u>			•	····			<del></del>	
GRADING	(CRD	C 103	(CUM:	To PASS	ING):		TE	ST RE	E111 7	Te I				1		T	FIR	è E
MZE /	(4.10		/	1	FINE	ł	1 6	31 KE.	SUL	131			먑	3/4	1/2		AC	G.
SIEVE	71	2 /1.	1	1 1	AGG.		. GR , SAT	SIRE DOV	/cen		07 108)	:		2.6h		1-	2.	2
SIEVE	12	2/4	2	<del>                                     </del>	<del></del>		ION, PER C							1.35				
				-			IMPURITE						علاما	الا و ما	200	+	1.	_
.51N.				<del>                                     </del>	· · · · · · · · · · · · · · · · · · ·											+==	_ 0	+
41N.			<u> </u>	<b></b>			ARTICLES,						<u> </u>	ļ		<del> </del>	+-	_
31N.				· · ·			T LIGHTE							-		<del> </del>		
2 1 IN			ļ				T FLAT A						3.4			<del> </del>		-
21N			ļ	-			D AV. % L						ļ	2.8		-	_7。	4
1 1 IN.	100		ļ				N LOSS (1				7): <b>11</b> A			32.4	<u> </u>	<del> </del>	4	
I IN.	74	100					., LB/CU			3):			97.1	99.7	02.	<b>d</b>	<u> </u>	8
} IN	12	88			<del></del>	CLAY LI	JMPS, 70	CRD-C II	8)				<b></b>	ļ	<u>.</u>			
1 IN.	3	30	100													↓		
in.	2	8	77		100	SPECIFIC	HEAT, BT	U/LB/DEG.	F. (	CRD-	C 124):			<u> </u>				
NO. 4	2	3	23		98	REACTIV	ITY WITH	NoOH (	RD-	C 126	3): Se,r	nH/L:				<u> </u>		
NO. 8	2	2	9		86	1					Rc, n	nM/L:				1		
HO.16	1	2	7		66		- MAKING											
NO. 30	1	2	5		. 38	TYPE I	ICEME	NT, RATH	• <u> 7                                   </u>	D	AYS,12	4	_3	_28	DAYS,	10	16	3
NO.50	1	2	10		15	LINEAR	THERMAL	EXPANS	ON )	KiO"9	DEG. F.	(CH	)-C 12	5,126):				
NO 100	0.9	1.2	2.5		1,		ROCK	TYPE	T	PARA	ALLEL	AC	ROSS	O	·	AVE	RAGE	7
NO.200	0.6	0.9	2.1		1.0													1
- 500 <sub>(e)</sub>			1.8	1	7 .),			······································						1		•		1
F.M(B)	7 78	6 0	E 77		2.93	1								†				1
a) CRD-	C 105	(b) C#	10-C 1		دوء٢	MORTA	A:					ــــــــــــــــــــــــــــــــــــــ		<del></del>				J
	*******					<u> </u>	Ī	FINE AG	GREG	ATE				COARSE	AGGR	EGATE		
- RATRON	K3 RAB	PANSIO	N AT IC	00F, %	(CRD-	C (23)	3 MO.	8 MO.	9 1	MO.	12 MQ	.   3	MO.	6 MO		MO.	12 1	40
LOW-A	LK. CEN	ENT:	. 1	70 Na-0	D EOUI	VALENT:	-		-			+			+-			
	LK.CEN					VALENT:	<del>                                     </del>	<u> </u>	<del> </del>			+			+	-		
OUNDNE			<del> </del>				L	l	L		·			FAT	14160	- C D	HD - I	
							cc Oss	·		<u> </u>		<u></u>	E 300		177		.,5=	
FINE A		POTDE	A AP	K. U		COARSE A		TDee V	gg.	cor	<b>P</b> a		£ 300	70				
		DA+	~ b + -	1441			1. G	- Forces	· in	h	no			10+4+	nen+		* + +	10
							neoret:											
one I	7.44 - 0.T.T.OM	ing.	perc	entag	ges:	フラルし	Granit	%⊥> و∃	_ V O. თ/ —	TC E	TT C2	77 و ص	ง ⊌U.a M=*-	11021 11021	, e	470	LARU	19
CITE,	4% F	myol	ite,	ے م <i>ار</i> د	cni	ST & S	Siltst	one, 3	љ D.	lor	ite,	<b>グ</b>	MILS	eTT9	v	ເຮ.	υr	
angula	ar to	sub	roun	ded .	Ligh	ttan	to bla	ack, c	Tesi	n a	ggre	gate	es ra	ange	Tron	1 50	⊥T 9	_
weath	ered	gran	ites	tol	nard	dens	e volc	anics.	A	ppr	OXIM	ate.	Ly 59	/% ai	SDTE	ys :	varj	<b>/-</b>
ing d	egree	s of	wea	ther	ing	and is	conf:	ined p	rim:	ari	ly to	o ti	re a	ranit	e, s	chi	st &	C
siltst	one	frac	tion	s. Ì	q of	otent:	ially (	delete	rio	us :	rock	ty	pes	occan	red <sub>,</sub>	ın	per-	•
centa	ges c	onsi	.dere	d cri	itic	al as	regar	ds use	of	th	is a	ggr	egate	e in	cond	ete	• ^	_
Children's	later	Tal	is o	1 av	erag	e qua	<del>Lity a</del>	nd is	con	sid	ered	-00	<del>- 60- (</del>	<del>citoc</del>	<del>r cot</del>	<del>ory</del>	<del>-1 01</del>	
	UIV	ITI. N	正TGH	r, II	o/cu	ft f	or 3/4'	' Blen	d 1	03.	7.	_ t}	ne ir	ntend	ed t	ıse.		

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STATE: M				EX NO				REGATE	L	ED BY:		Labora		3
	7150N		LON	4G.:	710	L	DATA	SHEET		-P	'ebruar	y 1955	Ĺ	
LAB. SYM	BOL N	0.: 5	5218				·	TY	DE OF	MATERIA	Crus	hed St	one	
LOCATION	4: <u>M</u>	alde	n, Ma	ssa	chuse	rtts				<u></u>	· · · · · · · · · · · · · · · · · · ·			
*. <del>2011-11</del>														
PRODUCE	R:	Rowe	Cont	rac	ing	Compa	ov .							·.
						· ·	_							
SAMPLED	BY:	New 1	Ingla	nd I	divis	i on			, .					
TESTED	FOR:	Bost	on Ar	my I	3ase									-
USED AT		Mil.	Cons	t. I	Ianso	on AF	Bed	ford. M	ass.	(195)	<u>-56)</u>			
		Mil.	Cons	tal	Bosto	n Arm	v Base	South	Bos	ton. M	lass. (	1954-5	6)	
PROCES	SING	SEFOR	T <b>E3</b> T	ING	Cri	shing	and S	izing b	v Pr	oducer	0			
GEOLOGIC	CAL FO	RIMATIO!	OMA, P	AGE:	·									
GRADING	(CRD	- C 108	)(GUM. °	To PAS	SING)		TE	ST RES	JLTS	, .			#13	/I.BFIN
NZE					FINE					·			4-5/	4 AG
SIEVE					AGG.	BULK SP.	GR , SAT	SURF DRY (	RD-C	107,108):			2.6	55
6 IN.	211	]18	3/4"	力마	3/8#	ABSORPT	IÓN, PER C	ENT (CRD-C	107,10	8):			0.3	3
51N.						OFIGANIC	IMPURITI	S, FIG. NO.	(CAD-C	151):				-1
4 IN.						SOFT PA	ATICLES,	PER CENT (	CRD-C	130):				
3 IN.						PER CEN	T LIGHTE	A THAN SP.		(CRD-C 12	:(0)	1		1-
2 j IN.	100					PER CEN	T FLAT A	ND ELONGATI	ED (CRD	-C 119,12	PO):	1	1	
2 IN	97				L	WEIGHTE	D AV. % L	098, 5 CYC. A	4 g 50a ( (	20-CH	5)		p.l	
i ₫ IN.	68	100				ABRASION	LOSS (	. A.),%, (C	RD-C I	17): .		T		6
I-IN.	21		100			UNIT WT	., LB/CU	FT (CRD-C	108):		1			
ILN.	5	29	97			CLAY LU	MPS, %	(CRD-C 118)	· ·					
₫ IN.	1	2	311	100										
ŽIN.	1	7			1.00	SPECIFIC	HEAT, BT	U/LB/DEG. F	. (CRD-	C 124):				
NO. 4	,		7	2				NeOH (CR			un!	<del>                                     </del>	и.	6
NO. B					9	1				Ac, mi		<del>                                     </del>	<u> </u>	3
NO. 16.	-				2	MORTAR -	MAKING	PROPERTIES	(CRD-				D-J. a	
NO. 30		<u> </u>			7	TYPE	CEMI	NT, RATIO_		DAYS.	<b>3</b>		AYS	
NO 50	<del></del>	1						EXPANSIO						<del></del>
NO 100					†		ROCK			ALLEL	ACROSS	ON	AVE	RACE
NO.200		<del>                                     </del>	-		1		·		+-			-	_	
- 500(e)	·	<del> </del>			<del> </del>	l			+			<del>- </del>		· · · · · · · · · · · · · · · · · · ·
F.M(b)		<del>                                     </del>	<del>                                     </del>		<u> </u>			·····				<del>}</del>	<del></del>	
(e) CRD~	·	(b) CF	D-C I	04	L	MORTA	a ·			<u> </u>			<u>:</u>	
					<del></del>			FINE AGGR	EGATE		1	COARSE A	GCREGATE	
MORTAR -	BAR E	(PANSIO	N AT IO	OF, 7	(CAD-	C (23):	3 MO.	<del></del>	9 MO.	12 MO.	3 MO.	8 MO.	9 MO.	1.2: M
LOW-A	U.H. CEI	MENT:		70 Na	O EQUI	VALENT:		-			<del>                                     </del>	1	-	
HIGH -A	NLH.CE	MENT:				VALENT:				<b></b>	<del>                                     </del>	<del> </del>	<del> </del>	<del> </del>
SOUNDNE	SS IN	CONCR							·	<u> </u>	<u> </u>	FRT	HW-CD	HD - CI
			m-Br			COARSE A	oc: Da	we Cont	Co		OFE soo	87	7W-CD	70-0
FINE A		10000	M-DI	aurc		COARSE A		MA COTTO	•00	·····	DFE 300	07		<del> </del>
PETROGR		DATA (	CRO-C	1273:						- <del> </del>	2. 5. 300		L.,	L
			ate :			rock		•					٠.	
			65%		· Cub	LOCK								
					3+30	inclu	on to	270						
	OTOL.						ISTON	• J1%						
_			lign	eous	roc.	Γ.					•			
4.1		ししせ =	4/6							*				
4.1	Gran:												•	
4.1	Gran:											•		*
4.1	Gran:				•							•		

STATE:	Maga		1640	XÉX NO.			400	REGATE	TERT	ED BY:	רומט ד	<b>h</b>		
	1420N	<del></del>		NG.:	71	S <sub>tat</sub>		SHEET			ORD La Februa	wy 100	orles_	
LAB. SYM			5521			71			PE OF			shed S		<del></del>
LOCATION			y, Ma		huse	tte		···············			<u> </u>	bited L	COLIG	
	~~~	ALITO,	110	Doac	,,,,,,,	005								<del></del>
PRODUCER	a: 010	1 00	mv	Crais	hed	Stone	Co	<del></del>	· · · · · · · · · · · · · · · · · · ·	<del></del>				
		2 00.		<u> </u>	<u> </u>	DUGLIC	00.	<del></del>			<del> </del>	<del></del>		
SAMPLED	BY:	New	Engl	and	Divi	gim	<del></del>	<del></del>	<del></del>					
TESTED F			ton A				<del></del>		<del>``````</del>		<del></del>			
USED AT		1000		hard the T.	Danc				·		······································			
							***************************************				<del></del>	<del></del> -	<del></del>	
PROCESS	SING E	FORE	E TEST	FING	Cr	nghine	bres 1	Sizing	hw Pr	odite	מיי			
GEOLOGIC	AL FOR	IOI TAIMS	AND	AGE:		- Laboratoria -				- <del> </del>	<b></b>	<del></del>		
		<del></del>										<del></del>		
GRADING	(CRD	- C 103	(CUM. 4	% PAS	SING):	1	TE	ST RES	ULTS			T	#4-3	///
AZE	ا				FINE			J. 1123	25,3)		ŀ	1 1	"   4	'/ <del>  </del>
SIEVE						BULN SP.	GR , SAT	SURF DRY (	CAD-C	07,108)			2.6	7
SIN.	211	7"	3/11	<u>ļ</u> n	3/8"	ABSORPT	ON, PER C	ENT (CRD-	107,10	8):		1 1	0.7	
5IN.				-				S, FIG. NO.				<b> </b>		
4IN								PER CENT (	<u> </u>			1		1-
.3 IN.								R THAN SP.	******		29):	<del>                                     </del>		
21 IN.	100					PER CEN	FLAT A	ND ELONGAT	ED (CRD	-C 119,i	20):	1 - 1	- + -	1
2 IN	99							098, 5 CYC.				1 1	h 7	
1 ± IN.		100						A.), %, (0				1 - 1		11
I IN.	3		100					FT (CRD-C				1 +		-
₹ IN.	7	58		700				CRD-C 118						+
JIN.	7	5		911	100		· · · · · · · · ·	<u>-</u>	***************************************			† †		_
IN.		2	3	48		SPECIFIC	HEAT, ST	U/LB/DEG.	CRD-	C (24):		1		_
NO. 4		7	2	10	211			NaOH (CF			W/L:	<del>                                     </del>		_
NO. 8					20					Re,m				1
NO,16					1	MORTAR-	MAKING	PROPERTIES	(CRD-	C (116)	<del></del>	<del></del>		
NO. 30						TYPE	CEMI	NT, RATIO	C	AYS,	<b>~</b>	0	AYS,	
NO 50											(CRD-C 12		· · · · · · · · · · · · · · · · · · ·	;
NO 100							ROCK	TYPE	PAR	ALLEL	ACROSS	ON	AVE	RAGE
NO. 200									1			1	2.	9
- 500 <sub>(4)</sub>		·											-	
F.M(b)							······································					1		
) CRD-C	: 105	(b) CR	D-C 10	04		MORTA	t:		·			<del></del>	<del></del>	
1007 AG . 4		****			/ca-		···	FINE AGG	REGATE			COARSE A	GGREGATE	
KORTAR - E	_~~ EA		4 AT 10	UF, 70	, CRU-	C (23)	3 MO.	6 MO.	9 MO.	12 MO.	3 MO.	6 MO.	9 MO.	12
LOW-AL	LK, CEM	ENT:	•	70 Naz	O EQUI	VALENT:								
HIGH -AL	LK.CEM	ENT:	-	70 Nog	O EQUI	VALENT:								
OUNONES	15 IN C	CONCRE	TE (CR	0 - C 4								F & T.	HW-CD	HD-
FINE A	GG WE	stor	-Bra	dfor	d o	COARSE, AC	:: 01d	Colony	•		OFE 800	81.		•
FINE A	GG.					COARSE AC	iG:				DF E 300			
ET ROGRA	PHIC (	MTA (	580 -C	127):										
	igne	ous	rock	90%	In	termed	iate	igneous	rock	و1% :	Dark A	phanit	ic roc	k 9
Acid										·				
Acid														
Acid														
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Acid					•			·.				•.		
Acid				· .						· .		•,		



FINE AGGREGATE

MANCHESTER SAND AND GRAVEL

MANCHESTER, N.H.

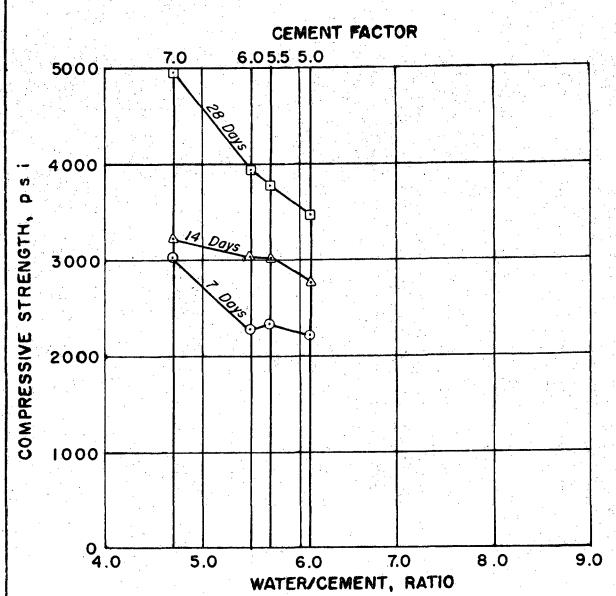
COARSE AGGREGATE
ROWE CONTRACTING CO.
MALDEN, MASS.

# NOTE:

CONCRETE WITH 2"MAXIMUM SIZE COARSE AGGREGATE, 6-INCH SLUMP. 6.0 % ENTRAINED AIR, TYPE I PORTLAND CEMENT. CHARLES RIVER DAM

CHARLES RIVER
CONCRETE MAKING
PROPERTIES

CHARLES RIVER, MASSACHUSETTS



FINE AGGREGATE

MANCHESTER SAND & GRAVEL CO.
HOOKSET, N.H.

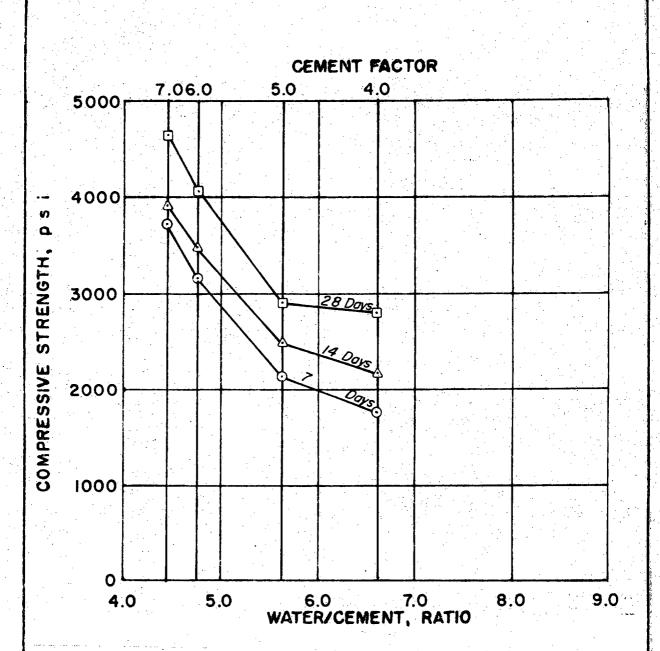
COARSE AGGREGATE
LYNN SAND & STONE CO.
SWAMPSCOTT, MASS.

# NOTE:

CONCRETE WITH I MAXIMUM SIZE COARSE AGGREGATE, 3-INCH SLUMP. 6.0 % ENTRAINED AIR, TYPE II PORTLAND CEMENT. CHARLES RIVER DAM

CHARLES RIVER
CONCRETE MAKING
PROPERTIES

CHARLES RIVER, MASSACHUSETTS



# PLAINVILLE SAND & STONE INC. PLAINVILLE, MASS.

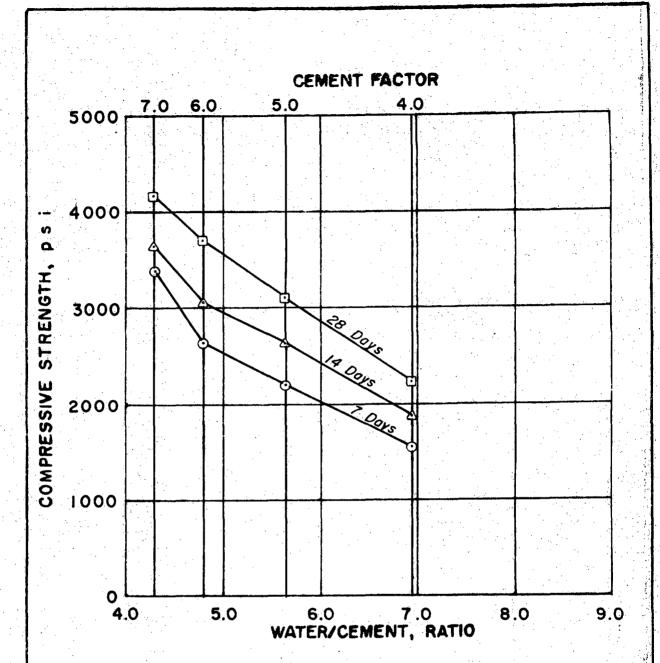
# NOTE:

CONCRETE WITH I 1/2" MAXIMUM SIZE COARSE AGGREGATE, 3 - INCH SLUMP. 6.0 % ENTRAINED AIR, TYPE II PORTLAND CEMENT.

CHARLES RIVER DAM

CHARLES RIVER
CONCRETE MAKING
PROPERTIES

CHARLES RIVER, MASSACHUSETTS



# OSSIPEE AGGREGATE CORP.

OSSIPEE, N.H.

# NOTE:

CONCRETE WITH 1 1/2" MAXIMUM SIZE COARSE AGGREGATE, 3-INCH SLUMP. 6.0% ENTRAINED AIR, TYPE II PORTLAND CEMENT.

CHARLES RIVER DAM

CHARLES RIVER
CONCRETE MAKING
PROPERTIES

CHARLES RIVER, MASSACHUSETTS